US INTRAFIRM TRADE: SECTORAL, COUNTRY AND LOCATION DETERMINANTS IN THE 90s*

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ABSTRACT

This paper studies the evolution and determinants of US intrafirm trade between 1989-98. We will extend previous similar econometric testing not only by using more recent data but also by considering inter-country differences in addition to inter-sectoral variation of intrafirm trade. At the sectoral level, relevant factors appear to be technology intensity, the level of vertical integration, economies of scale and the level of international production, as well as the impact of the geographic concentration of US parent firms. At the country level, the size of the market and some country specificities appear to favor intrafirm trade while increasing levels of the tax rate on profits of the foreign country and economic distance disincentives this trade. JEL classification: F10, F14, F23

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1. INTRODUCTION

In almost every year since the end of 1940s, the volume of international trade has grown faster than the volume of world production and, as a result, the degree of interdependence of the world economy has increased. A large share of this rapid growth of international trade has been accomplished under the control of multinational corporations (MNCs) and a good proportion of MNCs' imports and exports consists of intrafirm trade.

Despite this increasingly important role of intrafirm trade in international commerce, this phenomenon has not attracted much investigation in academic community. The reasons are twofold.

Firstly, intrafirm trade presents a substantial challenge to traditional trade theories. Most theorising on international trade assumes explicitly or implicitly that it is undertaken by unrelated buyers and sellers in world markets. However, motivation for the international exchange of goods on open markets may differ for transactions within the MNCs. While in the former decisions are relatively decentralised, in the latter they tend to be centralised - "hierarchical" transactions in (Williamson´s 1975) terminology. Apparently we need a new and specific theoretical framework to grasp the phenomenon, not yet available.

Secondly, data on intrafirm trade is scarce, and when it exists it is usually too aggregated. The United States (US) and Japan[1] are the only countries that systematically report on related party trade, but in the latter case data are too aggregated for the purposes of this paper. In the US case the Bureau of Economic Analysis (BEA) of the US Department of Commerce reports annually on intrafirm trade but disaggregated data available for consultation are restricted to the majority-owned foreign affiliates (MOFAs). For other countries only rarely is it possible to get a figure for the importance of total intrafirm trade.

These shortcomings explain the few studies we have on this subject. Those available aim mainly to identify at an empirical level, and in spite of the data limitations, the possible sources of intrafirm trade[2]. This paper belongs to this line of research.

We aim to investigate the factors determining the intrafirm trade of US firms in the period 1989-1998. We will extend previous similar econometric testing not only by using more recent data but also by considering inter-country differences in addition to inter-sectoral variation of intrafirm trade. Besides, among the factors considered we will also analyse the specific role of the concentration/proximity factors suggested by the Economic Geography theory. Our results will be conditioned by the high level of aggregation of our study (32 sectors and 34 countries), imposed by our data source. However, the panel nature of the data allows to partially overcome the reduced number of observations.

The paper goes as follows: next section presents a brief description of intrafirm trade of US firms between 1989 and 1998. Section 3 makes a short revue of some contributions to the hypotheses to be tested; the models and the variables used are described in section 4; in section 5 we present and discuss the results and finally we conclude in section 6.

2. THE EMPIRICAL EVIDENCE

In what follows we use the information of the BEA of the US Department of Commerce to analyse the major trends of US intrafirm trade (IFT) for the period between 1989 and 1998. Data for 1998 are preliminary.

Table 1 presents statistics for the share of US intrafirm trade in the US trade. As we can observe, the intrafirm trade represents a weight close to 40 percent of total US trade in all years. From 1989 to 1998, intrafirm trade varied between 37 percent and 44.1 percent. This means that US foreign trade data are probably highly sensitive to variation in the transfer pricing of MNCs. This fact in

itself justifies a special attention to this phenomenon, as its implications involve not only the Balance of Payments but also tax revenue considerations.

TABLE 1

Share of US IFT in the Total US Trade (1989-1998)

	1989	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**
Exports	38.1%	36.5%	32.7%	33.4%	33.5%	36.5%	35.1%	35.5%	36.0%	35.4%
Imports	48.7%	49.8%	43.1%	41.5%	39.8%	43.4%	41.6%	41.6%	39.8%	39.3%
Total	44.1%	43.9%	38.3%	37.8%	37.0%	40.4%	38.8%	39.0%	38.1%	37.6%

Source: US Bureau of Economic Analysis, US Department of Commerce

Since the value of this indicator varied very little in the period, we can assume that US intrafirm trade increased roughly at the same rate as the US trade. This is also true for the share of US intrafirm imports in the total of US imports and for the US intrafirm exports in the total of US exports. The indicator varied, in the latter case, between 32.7 and 38.1 percent (respectively, in 1991 and 1989) and, in the former, between 39.3 percent (in 1998) and 49.8 percent (in 1990).

We can divide this US intrafirm trade in two major categories: one that corresponds to IFT between US parent firms and their affiliates[3] in the rest of the World, and another relative to IFT between foreign parent firms and their affiliates[4] in the US (US affiliates, in what follows). There is, obviously, a third category that refers to the trade between US affiliates and foreign affiliates of the same group, but the BEA does not report these data.

From Table 2 we can observe the average share of intrafirm trade in these two groups for the period analysed. For the total intrafirm trade the values are similar: 20.4 percent for trade between US parents and their foreign affiliates and 18.6 percent for trade between foreign firms and their US affiliates. But the nature of this trade is different. The intrafirm trade between US parents and their foreign affiliates is, essentially, intrafirm exports (on average, 25.3 percent of total US exports) while the US affiliates' intrafirm trade is, basically, intrafirm imports (on average, 25.5 percent of total US imports).

TABLE 2

Share of US IFT in the Total US Trade reported between US Parents and US Affiliates from Foreign MNFs (1989-1998 average)

	US Parents	**US Affiliates**	**Total**
Exports	25.3%	9.8%	35.1%
Imports	16.5%	25.5%	42.0%
Total	20.4%	18.6%	39.0%

Source: US Bureau of Economic Analysis, US Department of Commerce

Comparing intrafirm exports of US affiliates with the intrafirm imports of US parents, we can observe that this value is higher (almost the double) in the latter case. In order to understand this result, we have to take into consideration that US affiliates export to several markets, while US parents are importing into a single, large and well developed market

The intrafirm trade statistics disaggregated by country are described in Tables 3 and 4. These tables report the US intrafirm trade in the total US trade but now at the bilateral level. This means that they describe the propensity of each US partner to trade through related parties instead of arms´ length. We analyse the case of the NAFTA members (Canada and Mexico), the European Union (EU), Brazil (the major developing economy with data available for all years) and Asia 5, that includes Hong Kong, South Korea, Taiwan, Singapore and Thailand.

TABLE 3

Share of US Bilateral IFT in the Total US Bilateral Trade (1989-1998)

	1989	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**
Brazil	23.2%	22.7%	21.8%	27.4%	31.3%	31.0%	27.4%	32.9%	29.7%	30.8%
Canada	44.3%	41.5%	42.3%	41.8%	39.8%	41.9%	39.9%	39.4%	39.5%	38.2%
Japan	70.9%	75.6%	75.0%	75.9%	72.2%	80.4%	78.2%	82.2%	77.5%	75.6%
Mexico	25.1%	25.5%	28.2%	28.8%	29.0%	32.0%	30.9%	31.9%	29.3%	28.2%
European Union	44.2%	41.2%	42.3%	44.1%	45.3%	48.1%	48.8%	48.4%	49.3%	48.7%
Asia 5	20.1%	21.1%	21.3%	20.2%	23.7%	26.2%	26.3%	29.5%	30.5%	33.3%

Source: US Bureau of Economic Analysis, US Department of Commerce

Data show this propensity is higher in the Japanese case. The share of US intrafirm trade with Japan in the US bilateral trade with this country is, on average, 75.6 percent, reaching 82.2 percent in 1996. The EU is second on this ranking, and presents a stabilised tendency in the end of the period, with around 48 % of total trade with US corresponding to intrafirm trade. Canada and Mexico have propensities of intrafirm trade around 40 and 30 percent, respectively, between 1989 and 1998. Considering that these countries have a free trade agreement with the US since 1994 (with the launching of NAFTA), we may conclude that NAFTA´s impact on the members' intrafirm trade and on the members' arms' length trade was similar.

TABLE 4

Share of US/EU Countries Bilateral IFT in the Total Bilateral Trade (1989-1998)

	1989	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**
Austria	26.9%	40.1%	39.9%	34.9%	36.3%	36.7%	36.8%	46.7%	36.2%	32.0%
Denmark	23.6%	20.2%	20.7%	23.8%	27.7%	22.6%	25.0%	27.5%	26.5%	27.2%
Finland	16.3%	22.5%	22.8%	33.4%	27.3%	48.7%	50.1%	39.0%	48.5%	51.8%
France	52.5%	49.0%	46.9%	50.0%	50.8%	59.3%	59.5%	55.3%	47.4%	42.2%
Germany	55.0%	52.6%	52.3%	53.9%	57.7%	62.5%	61.8%	60.4%	63.9%	61.0%
Greece	5.2%	3.4%	2.4%	2.1%	2.8%	2.5%	4.8%	3.0%	2.7%	2.2%
Ireland	43.4%	44.9%	43.6%	40.2%	34.9%	34.1%	41.3%	39.3%	44.2%	54.4%
Italy	23.2%	19.9%	21.3%	21.3%	22.0%	26.4%	25.4%	25.3%	26.9%	22.7%
Netherlands	48.2%	47.1%	51.5%	58.5%	62.3%	59.8%	59.9%	60.7%	78.8%	93.3%
Portugal	6.4%	8.9%	7.4%	8.1%	9.6%	5.2%	9.4%	9.0%	10.8%	10.4%
Spain	30.7%	16.3%	17.9%	17.6%	19.9%	19.8%	18.5%	21.3%	20.8%	19.9%
Sweden	61.3%	61.3%	60.8%	65.6%	68.9%	77.6%	64.3%	63.2%	73.7%	72.4%
United Kingdom	47.7%	45.2%	48.3%	48.5%	46.4%	49.8%	51.0%	49.9%	45.5%	42.1%
Belgium+Luxemburg	30.1%	27.6%	28.1%	29.4%	28.6%	27.5%	28.0%	27.5%	27.3%	29.0%

Source: US Bureau of Economic Analysis, US Department of Commerce

In what concerns EU members, Sweden, German, Netherlands and United Kingdom (UK) display the highest shares of bilateral intrafirm trade in the bilateral US trade, with values higher that 50 percent in almost all years. On the other hand, Portugal and Greece are the EU members with the

lower shares of intrafirm trade with the US economy, with values never higher than 11 percent. The remaining members have stable and moderate values for their intrafirm trade.

Next we analyse for the US partners signalled in the previous two tables, the weight of bilateral intrafirm trade in the total US intrafirm trade (Tables 5 and 6).

We can observe in Table 5 that for all years, but the last one, Japan was the major US intrafirm trade partner, even if, during the period analysed, the relative importance of this country decreased. Canada is second on this ranking. Between 1989 and 1998, the share of this country on total US intrafirm trade varied between 21.4 and 22.9 percent, displaying a clear stable tendency. For the other NAFTA member (Mexico), the share on US intrafirm trade is much lower, with values between 4.1 (in 1989) and 8.1 percent (in 1998), even if in this case there is a clear increasing trend.

TABLE 5

IFT by Country in the Total US IFT (1989-1998)

	1989	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**
Brazil	1.0%	0.9%	0.8%	1.0%	1.1%	1.1%	1.1%	1.3%	1.3%	1.3%
Canada	22.9%	21.4%	21.4%	21.4%	21.7%	21.4%	21.0%	20.7%	21.2%	21.0%
Japan	30.5%	30.9%	30.1%	29.8%	29.0%	29.2%	28.6%	27.2%	24.4%	22.6%
Mexico	4.1%	4.4%	5.2%	5.9%	6.1%	6.8%	6.5%	7.6%	7.7%	8.1%
European Union	23.6%	23.1%	23.0%	23.5%	22.9%	21.6%	24.2%	23.7%	24.8%	26.4%
Asia 5	6.7%	6.8%	7.0%	6.7%	7.9%	8.1%	8.9%	9.4%	9.5%	9.3%
Other Countries	10.2%	12.5%	12.5%	11.7%	11.3%	11.8%	9.7%	10.1%	11.1%	11.3%
Total	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*

Source: US Bureau of Economic Analysis

EU is, undoubtedly in the end of the period, the first major US intrafirm trade partner. The weight of this group of countries in the total US intrafirm trade is relatively stable until 1995, but starts increasing afterwards. Table 6 allows us to have a picture of this analysis by EU country.

TABLE 6

IFT by EU Countries in the Total US IFT (1989-1998)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Austria	0.17%	0.26%	0.27%	0.24%	0.26%	0.24%	0.28%	0.36%	0.27%	0.25%
Denmark	0.19%	0.18%	0.19%	0.20%	0.20%	0.16%	0.17%	0.19%	0.17%	0.19%
Finland	0.12%	0.16%	0.13%	0.18%	0.17%	0.29%	0.34%	0.34%	0.34%	0.39%
France	4.02%	3.87%	3.87%	3.97%	3.74%	3.78%	3.64%	3.31%	2.92%	2.94%
Germany	7.14%	7.27%	7.13%	7.28%	7.09%	6.70%	7.11%	6.82%	7.26%	7.78%
Greece	0.02%	0.01%	0.01%	0.01%	0.01%	0.01%	0.02%	0.01%	0.01%	0.01%
Ireland	0.55%	0.57%	0.58%	0.56%	0.47%	0.45%	0.66%	0.60%	0.78%	1.27%
Italy	1.38%	1.22%	1.24%	1.21%	1.12%	1.22%	1.25%	1.24%	1.28%	1.13%
Netherlands	2.43%	2.50%	2.71%	3.01%	2.95%	2.47%	2.68%	2.55%	3.60%	4.13%
Portugal	0.03%	0.05%	0.03%	0.04%	0.04%	0.02%	0.04%	0.03%	0.04%	0.04%
Spain	0.78%	0.41%	0.43%	0.41%	0.37%	0.34%	0.34%	0.38%	0.35%	0.34%
Sweden	1.53%	1.51%	1.37%	1.34%	1.23%	1.23%	1.17%	1.21%	1.32%	1.41%
United Kingdom	5.80%	5.84%	5.62%	5.61%	5.78%	5.44%	5.53%	5.41%	5.29%	5.19%
Belgium + Luxemburg	1.24%	1.22%	1.20%	1.17%	1.10%	1.03%	1.04%	0.98%	1.02%	1.13%

Source: US Bureau of Economic Analysis

In Table 6 we observe that Germany, United Kingdom, France and Netherlands dominate EU intrafirm trade with the US. These four countries are responsible for almost 75 percent of total intrafirm trade between EU and US in all years and represent about 30 percent of total US intrafirm trade. As noted above, Portugal and Greece have poor intrafirm trade shares, with less than 0.1 percent of total US intrafirm trade. We can also identify a third group of EU countries with moderate intrafirm trade shares that includes Spain, Sweden, Ireland, Italy and Belgium plus Luxembourg.

For all EU countries the values reported in Table 6 are relatively stable during the period analysed except for Netherlands and Ireland, which display a significant increase. In the Irish case, the observed trend is related to the increasingly volume of US foreign direct investment in this country.

The remaining table allows us to have a sectoral picture of the phenomenon. Table 7 shows the shares of sectoral intrafirm trade in the total US intrafirm trade in the period analysed. The most important remark is that about 50 percent of the US intrafirm trade occur in the manufacturing industry. On this respect, transportation equipment had the largest share (17.5 percent, on average) denoting the role of the automobile producers on multinational activities and, as a consequence, in related parties trade. Machinery and electric and electronic equipment also have substantial shares of US intrafirm trade.

TABLE 7

Share of Industry IFT in the Total US IFT (1989-1998)

	1989	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**
Petroleum	5.4%	7.0%	6.6%	5.5%	4.8%	5.2%	4.7%	4.7%	4.7%	4.7%
Manufacturing	47.8%	46.7%	47.9%	48.9%	48.9%	51.1%	52.6%	53.7%	57.0%	57.7%
Food and kindred products	1.2%	1.2%	1.3%	1.4%	1.5%	1.4%	1.2%	1.1%	1.1%	1.3%
Chemicals and allied products	5.6%	5.5%	5.8%	6.1%	5.9%	6.1%	6.3%	6.4%	4.3%	4.4%
Primary and fabricated metals	2.1%	1.7%	1.7%	1.9%	1.8%	1.9%	2.0%	1.9%	2.1%	2.0%
Machinery, except electrical	8.6%	9.1%	9.4%	8.8%	8.7%	8.9%	9.7%	10.1%	13.3%	13.1%
Electric and electr. equipment	6.8%	7.4%	7.7%	8.3%	8.3%	9.1%	9.5%	10.1%	7.8%	7.9%
Transportation equipment	18.5%	16.5%	16.4%	16.6%	17.1%	18.3%	18.4%	18.5%	19.0%	16.0%
Other manufacturing	5.2%	5.4%	5.6%	5.7%	5.5%	5.3%	5.5%	5.5%	9.8%	13.4%
Wholesale trade	45.4%	45.0%	44.1%	44.0%	44.9%	42.3%	41.4%	40.1%	37.5%	36.8%
Services	1.4%	1.3%	1.4%	1.6%	1.4%	1.4%	1.3%	1.5%	1.4%	0.8%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: US Bureau of Economic Analysis

US wholesale intrafirm trade also represents a large share of US intrafirm trade (42 percent, on average), indicating that a substantial part of US intrafirm trade is on final goods.

In our empirical modeling we will resort to the database of this section but with a restriction. We will use only information relative to the intrafirm trade between US parents and their majority-owned foreign affiliates (MOFAs[5]). This means that we are excluding trade between foreign MNCs and their US affiliates, i.e., around 50 % of total US intrafirm trade and 20 % of total US trade. The

reason to confine our analysis to these data is the more detailed information we can get, indispensable to our modelling (like in the case of research and development and taxes paid by the affiliates). Tables 3 to 7 were rebuilt for this reduced sample[6]. Comparison of the intrafirm values we get when we limit our analysis to MOFAs with the previous ones, suggests some noteworthy remarks.

First, in what concerns the share of the US bilateral intrafirm trade in the total US bilateral trade, the main alteration is the downfall of the prevalent role of Japan (a drop from more that 70 % to values never higher that 10%). This means that in the case of this country, intrafirm trade with the US is mainly due to the activity of US affiliates of Japanese MNCs, the US parents bearing a small role. In the case of the EU, US parents and US affiliates shares are similar on average. There are remarkable reductions in the values of bilateral IFT with the US in the cases of Denmark, Finland, France, Germany, Netherlands, Sweden and the United Kingdom, pointing out to the relevant role of US affiliates on the intrafirm trade of these countries.

Second, analysis of the weight of intrafirm trade by country in the total US intrafirm trade for MOFAs confirms the particular case of Japan, which displays very small values for MOFAs, but is among the most important US partners when US affiliates are also considered.

Third, when we take into consideration sectoral information for MOFAs, the weight of the manufacturing industry in the total US intrafirm trade increases, from an average value of 50 % to around 70 %. The reason is the fact that, by considering MOFAs only, we are excluding the intrafirm trade between foreign parent firms and their affiliates in a developed economy (the US), precisely a type of intrafirm trade that we expect to include a substantial amount of wholesale intrafirm trade.

3. THEORETICAL GUIDELINES

In order to understand the motivations for intrafirm trade it is necessary to consider the reasons for vertical and horizontal integration across international boundaries. What leads a MNC to

buy inputs and finished goods within the international corporate structure instead of acquiring them through the market? And why should purchases be done abroad and not to the national economy?

We do not dispose of formalised modelling that embodies in a systematic way the two aspects. However, it is possible to find relevant contributions in some conventional economic frameworks.

The literature on MNCs postulates that the expansion of firms abroad occurs in response to certain “monopolistic advantages” which allow quasi-rents such as scale economies, product differentiation, skills of various sorts, access to capital, advanced technology, and so on. The fact that internalisation is preferred to open market sales of these advantages has been taken to reflect imperfections in what may broadly be labelled “information markets” – (Hymer, 1960), and (Arrow, 1974). These imperfections are “market failures” which raise the cost of transacting open market sales, because of the difficulties inherent in fully appropriating the gains from the possession of superior “information” in open markets. Internalisation can also be analysed in the context of the transaction costs theory (Coase, 1937), in the sense that it is a matter of comparing the marginal cost associated to transacting through the open market with the marginal cost of the internalised trade.

Internalisation in the sense we have described offers unquestionably a good reason for investing abroad, but what we aim to explain is why trade is internalised. (Lall, 1978) suggests that the choice of a MNC to resort to intrafirm trade may also be viewed as a response to a market failure in commodity markets which renders recourse to external transactions either impossible or relatively costly. If failure in commodity markets involves commodities which embody new information (i.e., they are produced with superior technology), the reasons for investing abroad (technological superiority) will be similar to the reasons for intrafirm trade (highly specific products not available on open markets).

Another relevant theoretical body of analysis to our subject is the theory of vertical integration. Vertical integration is basically a matter of internalisation, when the latter occurs between different stages of the value-added chain. It is possible, however, to stipulate the following basic distinction.

While the internalisation of trade by MNCs refers to the choice between external and internal markets of firms that are already under common ownership and control, vertical integration can be seen as the act of merging of ownership (or taking over of one firm by another), independently of location considerations[7].

Both theories provide a number of plausible reasons for the fact that a firm may prefer to rely on affiliates for their transactions. All sources of quasi-rents like scale economies, advertising expenditures or technological intensity, should stimulate intrafirm trade. As a particular case of quasi-rent, (Lall, 1978) mentions the specificity of the product, in the sense of the "uniqueness" of high-technology products made by the MNC, not available in open markets. Uncertainty, like political instability, price changes, variation on quality of the inputs, may either impact positively or negatively, depending on whether it is associated to domestic conditions or external ones. For instance, factors deferring repatriation of foreign profits may constitute a disincentive to related parties' trade.

Intrafirm trade is, however, also a matter of location. In fact, the issue is what leads a MNC to locate its related party in a foreign country instead of resorting to domestic trade, whether intrafirm or market trade. Several reasons have been offered on this respect but with an *ad hoc* nature. Some of these factors are systematised by (Cho, 1988) in a kind of eclectic approach, which incorporates product, region, government and firm-specific factors. Among them, transfer pricing should be underlined. It has been recognised, for example, that firms may employ transfer-pricing techniques in order to maximize their after-tax earnings. In (Horst, 1973), the firm chooses either the lowest or the highest transfer price possible depending on a comparison of the relative differential in tax rate on profits between the importing and the exporting countries with the tariff rate, and (Eden, 1998) has shown that such transfer pricing can affect intrafirm trade. In any case one should expect a country's tax rate on profits to have influence on the magnitude of intrafirm trade flows and it is well known that one method for shifting profits between countries is to underprice goods sold to high tax countries and overprice goods sold in low tax countries. Such a strategy should imply that intrafirm trade flows to (from) high tax countries affiliates is low (high) relative to intrafirm trade flows to (from) low tax country affiliates. (Claussing, 1998) offered empirical evidence on this assumption for the US MNCs.

Intrafirm trade may also respond to exchange rate variations. Some authors argue that MNCs should be highly sensitive on this respect, due to superior international networks that allow informational advantages. By operating in different countries, they are able to alter sourcing and pricing decisions in response to exchange rate changes, insulating themselves from dramatic fluctuations. Cross-border investments and production facilities are thus likely to make fluctuations in exchange rates more tolerable for firms.

The concept of international and spatial division of labour has also been associated to intrafirm trade. Multinational firms allocate different phases of the production process to different countries on the basis of region characteristics in terms of technology and knowledge. The pattern that usually occurs is high-tech and managerial tasks allocated to core regions, while labour intensive standardized and non-qualified activities are allocated to periphery, and trade occurs between different regions but internally to the firms.

Finally, one should also consider factors suggested by the Economic Geography. It is possible that multinational firms, when searching for parents and/or foreign affiliates location, focus particularly on areas which their rivals have already explored and found satisfactory[8]. The reason might be a combination of centrifugal and centripetal effects, in the lines of (Fujita et al, 1999). Agglomeration is viewed here as a matter of external economies of scale, the hypothesis being that the profitability of each firm can be higher if other firms are nearby and this could be due either to vertical linkages-i.e., it is advantageous to be near suppliers of intermediates and buyers of final goods-, or to horizontal linkages, such as direct knowledge spillovers between firms and indirect knowledge links through a common, local pool of skilled labour or specialised management, for instance[9]. If this concentration effect occurs, it may impact negatively on the level of intrafirm trade, reducing the need of vertical/horizontal integration between related parties located in different countries.

However, in the context of the spatial division of labour, if geographical concentration occurs in particular parts of the value added chain of multinational production, the relation of industrial agglomeration and the level of intrafirm trade may be positive. For instance, if semi-finished products

and other kind of inputs are produced in local industrial networks and sent to other plants in other locations and agglomerations – (Scott and Storper, 1992). In this context, agglomeration economies will stimulate intrafirm trade of the vertical type.

Finally, geographical distance should disincentive trade of related parties, not only by increasing risk and uncertainly but also on account of the fact that it can diminish market accessibility.

4. THE EMPIRICAL MODELLING

Taking support on the theoretical references above mentioned and also on the empirical evidence from several studies, it is possible to formulate some hypothesis on the impact of the determinant factors of intrafirm trade of US firms between 1989-98.

As previously explained, our dataset confines the estimates to intrafirm trade between US parents and the MOFAs, thus excluding the trade between foreign MNCs and their affiliates in the US.

Besides, we had to consider only the case of the manufacturing industry, which according to our data represents more than two thirds of intrafirm trade. A larger sample was not treatable due to missing data[10]. This means that we excluded distributional activities and other services, including the case of the typical trade with an affiliate that engages in nothing but sales activity.

Finally, our data do also preclude the possibility of separating the finished products relatively to the intermediate ones used in production.

We will explore the industry and country characteristics associated with intrafirm trade but with distinct models. Alternatively we could have introduced simultaneously in the same equation both national and industry-specific variables. However, we are sceptic about the advantage of this doing when the observation for the industry (product) is the same for every country involved in each bilateral transaction. In fact, due to the data requirements, both home and foreign country conditions on

industry characteristics have to be proxied with just home-country conditions on the equivalent industry for every country involved in the bilateral trade. Of course, separate estimations do not overcome this shortcoming, but at least we do not have to explicitly attribute a value at the industry level for each bilateral transaction[11].

The "industry model"

In the "industry model" we considered 34 sectors and the following five hypotheses:

H1.1. The propensity of an industry to intrafirm trade is positively related to the extent of **vertical integration (VI)** in that industry.

H1.2. The propensity of an industry to intrafirm trade is positively related to the **intensity of international production (IP)** (as a pre-condition to intrafirm trade) of that industry.

H1.3. The propensity of an industry to intrafirm trade is positively related to the **technology intensity (TI)** of that industry.

H1.4. The propensity of an industry to intrafirm trade is positively related to the level of **economies of scale (ES)** in that industry.

H1.5. The propensity of an industry to intrafirm trade is related to the level of US parent firm **spatial (geographic) concentration (GC)** on that industry. This variable aims to capture agglomeration economies and the expected sign is ambiguous, depending on whether the industry concentrated concerns only a part of the value added chain (for instance, intermediate inputs, traded with final products in the foreign market) or covers a significant part of the production process. In the former case, geographical concentration may stimulate intrafirm trade; in the latter, it will tend to produce low or even null levels of intrafirm trade (considering that the distribution activities are not included in our data).

Thus, five regressors compose the “industry model”:

VI_{it}, an indicator of the extent of vertical integration for industry *i* in *t*, is the ratio of value added in industry *i* to the industry *i*'s total sales during year *t*. We build the variable without profits in the numerator and denominator to get the “adjusted vertical integration index” of (Tucker and Wilder, 1977).

IP_{it}, the intensity of international production, is proxied by the simple average between year *t-1* and *t* of the ratio of total assets of US parents´ foreign affiliates in industry *i* over total assets of US parents in the same industry.

TI_{it} is an indicator of the technology intensity given by the ratio of Research & Development expenditure in industry *i* to the industry *i*'s total sales during year t.

ES_{it}, is an indicator of the level of economies of scale of an industry proxied by the ratio of the average sales per firm in industry *i* to the average sales per firm in all industries.

GC_{it} is the Gini coefficient for industry *i* in year *t*. It was build considering five major regions in the US: New England, Mideast, Great Lakes, Plains, Southeast, Southwest, Rocky Mountains and Far West.

Given these variables, the basic “industry model” is expressed as:

$$IFT_{it} = \beta_0 VI_{it} + \beta_1 IP_{it} + \beta_2 TI_{it} + \beta_3 ES_{it} + \beta_4 GC_{it} + E_{it} \quad (1)$$

(*i*=1, 2, .., *32*; *t*=1,2, .., 10),

where the dependent variable is an indicator of the propensity to intrafirm trade, that is, **IFT_{it}** is the share of industry *i* intrafirm trade in the total sales[12] of industry *i* during year *t*. **Eit** stands for the disturbance term for the ith unit (industry) at time (year) t.

The "country model"

In the "country model" we consider 36 countries and the following hypothesis:

H2.1. The intrafirm trade between US and country *j* is positively related to the market size of trade partners (**GDP**).

H2.2. The intrafirm trade between US and country j is negatively related to tax rate on profits in country *j* (**PTR**)[13].

H2.3. The intrafirm trade between US and country *j* is related to the exchange rate (**EXR**) between US dollar and country *j* currency. A negative sign should be expected if we are considering the import flows but positive for the export side. Thus, if we take both flows, the expected sign is ambiguous.

H2.4. The intrafirm trade between US and country *j* is negatively related to the distance between two nations (**DIST**).

H2.5. The intrafirm trade between US and country *j* is negatively related to risk increase in country j **(RISK).**

In order to control for the effect of risk on bilateral IFT, we added a proxy for risk constructed for each one of the countries of our sample with the Risk Country Index published every six months by the European Review. It was built as the difference between the value of the index for the US and for each one of the partner countries, lagged of one or more years. The expected impact of this variable on IFT is negative, because if the risk differential in the market of the US parents´ foreign affiliates increases, US parents will tend to decrease their presence by reducing foreign direct investment.

Accordingly, the following regressors compose the "country model":

GDP_{jt}, the product of the US Gross Product and the Gross National Product of country *j* in year *t*; **PTR_{jt}**, the tax rate on profits of country *j* at year *t*, which is proxied by the share of income taxes paid by MOFAs in their total income for country *j* during year *t*; **EXR_{jt}**, the real exchange rate between US dollar and country *j* currency at year *t*; **$DIST_{jt}$**, the distance between Chicago and major trading city in country *j*; **$DUMMIES_j$**, the country dummies with value one for the country considered and zero otherwise; **$RISK_{j,t-1}$**, the difference between risk in the US and in the foreign partner lagged of one (or more years).

Considering the explanatory variables, the "country model" is expressed by the equation (2):

$$IFT_{jt} = \beta_0 GDP_{jt} + \beta_1 PTR_{jt} + \beta_2 DIST_j + \beta_3 EXR_{jt} + \beta_4 DUMMIES_j + \beta_5 RISK_{j,t-1} + E_{jt} \quad (2)$$

(i=1, 2, .., 36; t=1,2, .., 10)

where **IFT_{jt}**, is an indicator of intrafirm trade constructed in two different ways. First, we will use the total volume of intrafirm trade between US and country *j* at year *t* at 1993 constant (market) prices. In a second step, we will use, alternatively, the share of US bilateral intrafirm trade in total bilateral trade between US and country *j* in year *t*. The reason to consider the second measure is the fact that we should not depreciate intrafirm imports and exports with the import and export market price index, but with an index based on transfer prices, which, nonetheless, is not available.

The second indicator is also however subject to criticism. In fact, on one hand, it allows to by-pass the fact that an appropriate price level deflator is not available; but, on the other hand, being a measure for the propensity of the US to have intrafirm trade with country j, the level of intrafirm trade may be increasing while this ratio is decreasing, if a higher proportional increase is occurring in the total bilateral trade level.

The proxies were built using the IMF data for GDP, real exchange rate and price indexes for the 1989-1997 period. US Bureau of Economic Analysis (BEA) data is used for the other indicators. Distance is calculated between Chicago and the major city in the partner country. GDP and trade data are in constant 1993 prices using the GDP and the import/export price indexes published by IMF and US Labour Department, respectively.

The various equations are estimated in terms of a panel sample. The fundamental advantage of a panel set over a cross section is that it will allow the researcher far greater flexibility in modelling differences in behaviour across individuals. In both models we tested the hypothesis that the constant terms are all equal with an F test. If the null hypothesis is accepted, the efficient estimator is pooled least squares. But if we accept the existence of fixed effects, the ordinary least squares still provides consistent and efficient estimates of the regressors provided that we include dummy variables for the specific effects. The t-statistics are corrected of heteroscedasticity with the White method. Examination of the correlation coefficients of the explanatory variables do not suggest multicollinearity.

In the industry model, our dependent variable assumes values in the interval (0,1). The correctness of the functional form of the OLS regression in this case is questionable considering the possibility that the predicted value for the dependent variable may fall outside the feasible interval. However, following other authors who faced a similar problem, we opt for the OLS estimation for three reasons. First, it is not clear which alternative functional form should be used[14]. Second, this problem is less critical if the purpose is “hypothesis testing” , as it is the case, than if the equation is used for forecasting/prediction. Third, in the light of the data deficiencies and proxy problems encountered in such work, it is questionable whether to sophisticate the OLS method is merited, as also pointed out in the intra-industry trade literature (Greenway and Milner, 1986, p. 131).

It is possible that some of the factors determining intrafirm trade impact differently according to whether we are considering exports or imports. We also estimated both models disentangling the dependent variable according to this distinction. In the country model the results are similar to the model with the intrafirm trade balance, suggesting that the same factors affect both sides. In the

industry model, we face serious data limitations and, perhaps on account of that, the explanatory power of the regression is very poor.

5. EMPIRICAL RESULTS

The "industry model"

Results for the "industry model" are presented in see Table 8. The explanatory power of the model is high. The technological intensity and vertical integration coefficients are statistically significant with the expected sign. The economies of scale and international production variables are significant, the former with a positive sign and the latter with a negative one. These results are reasonable in economic terms if we consider that the economies of scale are a well known source of quasi rents and the world is more and more featured by the volatility of the installed firms.

TABLE 8

Industry Model Regression

Dependent Variable **Regressors**	**Intrafirm trade**
C	-0.07*** (-2.51)
TI	0.896*** (77.293)
ES	0.003** (2.276)
VI	0.063** (2.494)
IP	-0.0001*** (-3.109)
GC	-0.007* (-1.856)
R2	0.979
R2 Adj.	0.961
N	320
$F(\alpha,\beta=\alpha_i, \beta)$	1.238 (H0 accepted 5%)

t-statistics (between brackets) White-corrected
***1% significance level
**5% significance level
*10% significance level

The result for the degree of spatial concentration of parent firms appears to be negatively correlated with intrafirm trade. The reason for a negative correlation may be that parent firms in the

US, if they search for agglomeration economies and therefore geographically concentrate, tend to "clusterise" (in the sense of (Porter, 1990)), that is to say, spatial concentration of an industry concerns a significant part of the value added production process. Of course we can not exclude that intrafirm trade of these firms occurs in the distribution and other service activities not included in our data.

There might exist industry individual effects, which are taken to be constant over time and specific to the individual cross-sectional unit. However, with the test F performed to the equality of these coefficients, the null is not rejected.

The "country model"

Table 9 shows the results for country model when the dependent variable is the total volume of intrafirm trade between US and country j (at constant prices). The explanatory power of the model is good (the adjusted R2 is 0.570). We confirm that the dimension of the markets impact, as measured by their GDP, positive and significant. Tax rate on profits displays the negative expected result.

The exchange rate variable was not significant, what led us to exclude it from the results. The reason might be the fact that US parent firms envisage the external markets as basically stable in what concerns exchange rate variations. However, the most plausible reason is the fact that an opposite sign should be expected depending on whether we are considering the import flows (negative) or the export side (positive), the effect being cancelled when the trade balance is considered.

The distance variable has the expected negative impact on intrafirm trade.

We added two dummies to capture country idiosyncrasies. This was suggested, on one hand, by the above-mentioned F test to the equality of the coefficients. In fact, now the null is rejected. On

the other hand, the descriptive analysis of section 2 clearly suggests country asymmetries in bilateral intrafirm trade with US firms. We included dummies for the case of countries with trade agreements- NAFTA and EU countries-, but only in the first case we get a significant result (and positive, as expected).[15] The fact that the EU variable is not significant can be related to the heterogeneity of the countries that belong to this block in terms of the phenomenon we are analysing (see Table 6). We also included a dummy for the UK case, to capture whether the particular historical, cultural and linguistic relations impact positively on the level of intrafirm trade, what in fact is statistically confirmed.

Finally, we do not confirm the negative impact of the risk proxy. However, countervailing effects may be expected if we take into consideration that US parents will probably overprice exports and underprice imports in their intra-firm trade with MOFAs, in order to transfer profits from the country where risk, in relative terms, has increased, to the US parents; the expected decrease on intrafirm trade based on FDI considerations may thus be, at least in part, annihilated, in what concerns the intrafirm trade of exports or even of both flows (exports and imports).

TABLE 9

Country Model Regressions

Dependent Variable **Regressors**	**Intrafirm trade**
C	12.207***
	(3.084)
GDP	0.045***
	(14.310)
PTR	-72.7544***
	(-3.709)
DIST	-0.008**
	(-2.323)
NAFTA Dummy	56.467***
	(5.671)
UK Dummy	5.907***
	(3.287)
R2	0.574
R2 Adj.	0.570
N	340
F (α,β=α_i, β)	91.348
	(H0 rejected)

t-Statistics (between brackets) White-corrected
***1% significance level
**5% significance level
*10% significance level

Table 9 displays only the estimation with the significant variables, considering that inclusion of the EU dummy and the risk variable, similarly to what occurs with the exchange rate variable, does not have remarkable effects on the remaining variables.

As we have previously explained, we also used, as an alternative to the dependent variable of table 9, the share of bilateral intrafirm trade in the bilateral trade. The explanatory power of the model however diminishes dramatically (the adjusted R2 is only 0.089). Criticism pointed out to this second measure may explain this disappointing result.

6. CONCLUDING REMARKS

This paper studies the evolution and determinants of US intrafirm trade between 1989-98 reported by the Bureau of Economic Analysis of the US Department of Commerce.

In what concerns the main characteristics of US intrafirm trade, it is worthwhile mentioning that Japan is the country with the highest values for bilateral intrafirm trade with US in the total US bilateral trade, followed by the EU and Canada, and these three partners also represent the highest shares of total US intrafirm trade. However, when we consider only intrafirm trade of MOFAs (thus excluding intrafirm trade managed by US affiliates of foreign parent firms), the prevalent role of Japan drops dramatically and the values for the EU decreases to half, thus pointing out to the relevant role of US affiliates on intrafirm trade of these countries. Considering MOFAs only, the weight of the manufacturing industry in the total US intrafirm trade increases from an average of 50% to around 70%, suggesting that intrafirm trade between foreign parent firms and their affiliates includes a substantial amount of wholesale intrafirm trade.

Our attempt to explain the determinant factors of the US intrafirm trade was conditioned by the quality of the data. In fact, our figures have some obvious limitations and suggest some prudence for general conclusions. First of all they concern only MOFAs, excluding from our sample the intrafirm trade conducted by US affiliates of foreign parent firms. Second, they do not allow to distinguish trade of finished goods from trade on intermediate products. Third, they concern only manufacturing activities, thus excluding sales and after-sales activities, even if they represent only an unilateral flow (imports or exports) of intrafirm trade. Fourth, some apparently relevant factors could not be tested due to lack of data (such as excess capacity and other host governments' policies). Finally, work with

data at the firm level would be relevant as firms can be highly heterogeneous in a given sector. In spite of these shortcomings, the empirical results of both the model to explain inter-sectoral variation and the model for inter-country differences appear to be in general interesting and work well in terms of their explanatory power.

Summarising our statistical results, the factors that affect the US intrafirm trade managed by MOFAS are technology intensity, the level of vertical integration, economies of scale, the level of international production, as well as the impact of the geographic concentration of US parent firms. The fact that location considerations related to agglomeration economies appear to impact negatively on intrafirm trade, is not surprising. It is reasonable to assume that industries that search for agglomeration economies tend to geographically concentrate a significant part of the value added production process. This does not mean that the spatially concentrated industries do not transact on related parties. If we take into consideration that wholesale trade and services are excluded from our data, it is possible that “clusterised” industries engage on related party trade in sales and after sales activities. In any case, this is a subject for further research.

At the country level we also identified some relevant factors. The size of the market appears to favour intrafirm trade while the level of the tax rate on profits of the foreign country disincentives this trade. As expected, country specificities appear to impact positively in some cases, such as being member of the NAFTA or displaying cultural affinities, like in the UK case. Finally, US parents prefer to transact internally with less distant countries, as expected.

As regards specification, some further points can be raised. First, more theory before pursuing the empirical work would be most valuable. There is still a long theoretical path to run to prove the relation between intrafirm trade and factors related to characteristics of the foreign markets internalised, such as the sensitivity of trade to exchange rate variations, the role of transfer pricing and restrictive business practices, or the role of geographical factors. Second, a most relevant question seems to be not whether intrafirm trade occurs more or less in an industry or a country but rather if it behaves differently from trade between unrelated parties, as pointed out by Helleiner since

his seminal paper of 1979. Third, much more detailed data should be provided in order to allow new and better insights on the phenomenon.

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Footnotes

[1] Jetro is the Institution responsible for this kind of statistics.

[2] See Lall (1978), who represents one of the first systematic attempt to explain interindustry differences in the US intrafirm exports, and Helleigner and Lavergne (1979), who explained interindustry differences in the US intrafirm imports.

[3] A "foreign affiliate of a US parent firm" is defined by the US Department of Commerce as a foreign business enterprise in which a US person owns or controls 10 percent or more of the voting securities or the equivalent.

[4] According to US Department of Commerce, a "US affiliate of a foreign parent firm" is a US business enterprise in which a single foreign person owns or controls, directly or indirectly, 10 percent or more of the voting securities or equivalent.

[5] According to the Department of Commerce, this concept includes all foreign affiliates in which the direct and indirect ownership interest of all US parents exceeds 50 percent.

[6] Data will be supplied on request.

[7] See Lall (1978) for this distinction.

[8]Preliminary evidence of this possibility is supported by Barrell and Pain (1999) on the concentration of the stock of US manufacturing FDI in Europe.

[9]See, on this purpose, Flôres et al (2000), p. 22 and following.

[10] In the non-manufacturing industry, we have several "missing values" due to protection of information.

[11] See a similar argumentation but for the case of an intra-industry model, in Crespo and Fontoura (2001).

[12] It was not possible to use total trade due to the missing values of the dataset in the case of some sectors.

[13] The tax rate is the foreign income tax paid by affiliates in a given country relative to their net (before tax) income.

[14] We tested for an alternative functional form which restricts the predicted value to the limited range: the logistic function, estimated with non-linear least squares. Similarly to the OLS model, we verify a positive impact of technology intensity and the level of vertical integration.

[15] We also run a least squares dummy variable model, with a dummy variable for each country, but this grouping significantly increases the explanatory capacity of the model.